

## Federal Energy Management Program (FEMP) Operations and Maintenance Best Practices Guide

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## Presentation Overview

- ❖ Operations and Maintenance Best Practices Guide (O&M BPG) genesis
- ❖ O&M BPG goals
- ❖ O&M BPG layout and content
- ❖ Current status
- ❖ Future delivery

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## Acknowledgements

- ❖ PNNL co-authors: Ray Pugh, Aldo Melendez
- ❖ PNNL graphics/editing staff: Dave Payson, Kathy Neiderheiser, Cindy Gregg
- ❖ FEMP visionaries: Ab Ream, Beth Shearer

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## O&M BPG Development: For whom, why, and how?

- ❖ Target audience - Federal O&M/energy/facility managers and practitioners
  - ✓ Understaffed and being "squeezed"
  - ✓ Movement towards "contracted services"

Question: private sector similarities?

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## O&M BPG Development: For whom, why, and how?

- ❖ Recognition that O&M is a "resource"
  - ✓ Compares well with other efficiency-related activities
  - ✓ Should be considered as the "*first*" option before capital upgrade
    - Low-cost nature of opportunity
    - Measures usually done with in-house staff
    - Can have immediate payback (no sharing of savings)
    - Minimum upfront cost/time for design, bids, evaluation, etc.

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## O&M BPG Development: For whom, why, and how?

- ❖ Based on interaction with Federal staff
  - ✓ FEMP O&M Management workshop
  - ✓ On-going work at various sites
- ❖ Literature searches
- ❖ Equipment vendors
- ❖ Industry experts

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## O&M BPG Development: **DISCLAIMER**

- ❖ This guide is NOT the universe of O&M
- ❖ This guide is not a "cookbook"
- ❖ We recommend modifications only within *"manufacturer's specification"* and guidelines
  - ✓ *"Manufacturer's specification"* supercede BPG recommendations

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## O&M BPG Development: **DISCLAIMER**



Actions and activities recommended in this guide should only be attempted by trained and certified personnel. If such personnel are not available, the actions recommended here should not be initiated.



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## O&M BPG: Layout and Contents

- ❖ Chapter 1 - Info
- ❖ Chapter 2 - Rational for enhanced O&M
- ❖ Chapter 3 - O&M Management issues
- ❖ Chapter 4 - CMMS
- ❖ Chapter 5 - Maintenance programs
- ❖ Chapter 6 - Maintenance technologies
- ❖ Chapter 7 - O&M procedures

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## O&M BPG: Layout and Contents

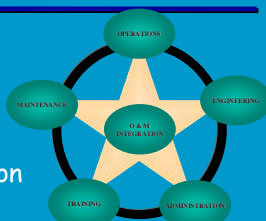
- ❖ Chapter 8 - O&M Horizons
- ❖ Chapter 9 - 10 steps to *Operational Efficiency*
- ❖ *Appendix A - Glossary*
- ❖ *Appendix B - Federal contact list*
- ❖ *Appendix C - O&M orgs./trade groups*
- ❖ *Appendix D - Suggestion form*

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## O&M BPG Chapter 3: O&M Management

- ❖ OMETA concept
- ❖ Measuring your O&M program
  - ✓ Metrics to consider
- ❖ Program implementation
  - ✓ Develop a path for success
- ❖ Selling O&M to management
  - ✓ Language of the decision makers
  - ✓ Educate the management chain



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## O&M BPG Chapter 4: Computerized Maintenance Management Systems

- ❖ CMMS capabilities
  - ✓ Know what you want
- ❖ CMMS selection
  - ✓ Know what you can afford
    - Installation costs, staff time, upkeep
- ❖ CMMS pitfalls
  - ✓ Selection, training, commitment
- ❖ Benefits
  - ✓ Optimization

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## O&M BPG Chapter 5: Maintenance Programs

- ❖ Program types, advantages/disadvantages
  - ✓ Reactive maintenance
  - ✓ Preventive maintenance
  - ✓ Predictive maintenance
  - ✓ Reliability centered maintenance (RCM)
- ❖ Guidance in RCM program development
  - ✓ Steps to design

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## O&M BPG Chapter 6: Predictive Maintenance Technologies

- ❖ Present equipment descriptions and operating principles
  - ✓ Operation of technology
  - ✓ Applications
  - ✓ Cost effectiveness/typical paybacks
  - ✓ Case studies

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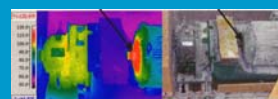
## O&M BPG Chapter 6: Predictive Maintenance Technologies

- ❖ Presented by technology with costs and case studies
  - ✓ Thermography
  - ✓ Oil analysis
  - ✓ Ultrasonic analysis
  - ✓ Vibration analysis
  - ✓ Motor analysis
  - ✓ Performance trending

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## O&M BPG Chapter 6: Thermography



Motor bearings



Electrical contacts

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## O&M BPG Chapter 6: Thermography

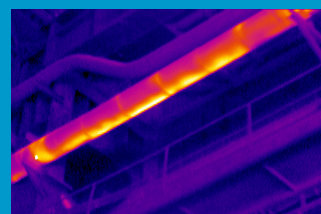


Trending of a motor coupling

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## O&M BPG Chapter 6: Thermography



Insulation differences

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## O&M BPG Chapter 7: O&M Ideas for Major Equipment Types

- ❖ Present equipment descriptions and operating principles
  - ✓ Key components, failure modes
  - ✓ Cost/efficiency
  - ✓ Recommended O&M activities
    - Maintenance checklists
  - ✓ Safety issues

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## O&M BPG Chapter 7: Safety Issues

# CAUTION

IF YOU THINK OSHA IS  
A SMALL TOWN IN  
WISCONSIN:  
YOU'RE IN  
TROUBLE!

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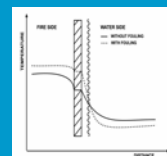
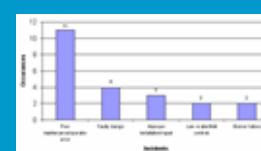
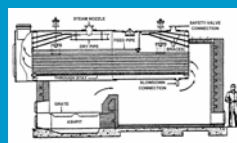
## O&M BPG Chapter 7: O&M Ideas for Major Equipment Types

- ❖ Boilers
- ❖ Steam traps
- ❖ Chillers
- ❖ Cooling towers
- ❖ Energy Management Systems
- ❖ Pumps
- ❖ Fans
- ❖ Electric motors
- ❖ Air compressors
- ❖ Lighting

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## O&M BPG Chapter 7: O&M Ideas for Major Equipment Types – Boilers



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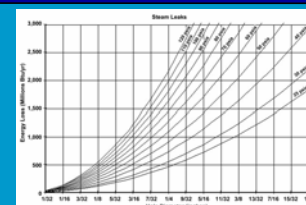
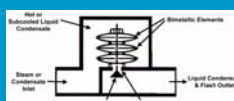
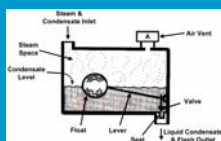
## O&M BPG Chapter 7: O&M Ideas for Major Equipment Types – Boilers

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Boiler use/sequencing	Turn off/sequence unnecessary boilers	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Follow manufacturer's recommended procedures in lubricating all components	Compare temperatures with tests performed after annual cleaning	X			

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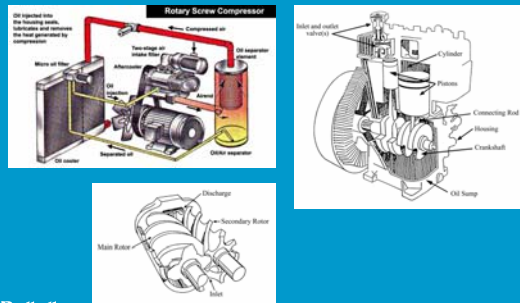
## O&M BPG Chapter 7: O&M Ideas for Major Equipment Types – Steam Traps



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## O&M BPG Chapter 7: O&M Ideas for Major Equipment Types – Air Compressors



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## O&M BPG Chapter 8: O&M Frontiers

### ❖ New tools and technologies

- ✓ HVAC Service Assistant
- ✓ Decision Support through Operations and Maintenance (DSOM<sup>®</sup>)
- ✓ Performance and Continuous Commissioning analysis Tool (PACRAT<sup>®</sup>)
- ✓ Whole-Building Diagnostician (WBD)

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## O&M BPG Chapter 9: Ten Steps to *Operational Efficiency*

- ❖ Ten-step process to operations and maintenance serenity
  - ✓ Increasing management awareness... tracking O&M activities
  - ✓ I.D. troubled equipment/systems... addressing ONE of these systems
  - ✓ Operate this ONE system efficiently... purchase/contract some form of diagnostics capability
  - ✓ Complete project and highlight success... Begin again!

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## O&M BPG: Next Steps and Future

- ❖ Release 1 currently available
  - ✓ Hard copy
  - ✓ CD ROM version (pdf. Of hard copy)
  - ✓ FEMP web site: [www.eere.energy.gov/femp](http://www.eere.energy.gov/femp)
- ❖ Release 2 to include updates and new sections
  - ✓ O&M contracting
  - ✓ Metering for O&M
- ❖ Considering development of an "interactive" web/training version of guide

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## FEMP O&M BPG Contact

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